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Datasheet for the decision
of 26 January 2022

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Title of invention:
Broad molecular weight distribution polymers with a reverse comonomer distribution and low levels of long chain branches

Patent Proprietor:
Chevron Phillips Chemical Company LP

Opponent:
Borealis AG

Relevant legal provisions:
EPC Art. 54, 56, 100(b)

Keyword:
Sufficiency of disclosure - (yes)
Novelty - (yes)
Inventive step - (yes)

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Case Number: T 0586/19 - 3.3.03

DECISION
of Technical Board of Appeal 3.3.03
of 26 January 2022

Appellant: (Patent Proprietor)	CHEVRON PHILLIPS CHEMICAL COMPANY LP 10001 Six Pines Drive The Woodlands, TX 77380 (US)
Representative:	Potter Clarkson The Belgrave Centre Talbot Street Nottingham NG1 5GG (GB)
Respondent: (Opponent)	Borealis AG Wagramerstrasse 17-19 1220 Vienna (AT)
Representative:	Dehns St. Bride's House 10 Salisbury Square London EC4Y 8JD (GB)
Decision under appeal:	**Decision of the Opposition Division of the European Patent Office posted on 20 December 2018 revoking European patent No. 2703419 pursuant to Article 101(3)(b) EPC.**

Composition of the Board:

Chairman	D. Semino
Members:	D. Marquis
	F. Bostedt

Summary of Facts and Submissions

I. European patent No. 2 703 419 was opposed on the grounds of Article 100(a) EPC (novelty and inventive step) as well as Article 100(b) EPC. The appeal lies with the decision of the opposition division posted on 20 December 2018 to revoke the patent.

II. Claim 1 as granted read as follows:

"1. An ethylene polymer having a melt index from about 0.1 to about 100 g/10 min; a ratio of Mw/Mn from 3 to 6; a reverse comonomer distribution; less than 0.008 long chain branches (LCB) per 1000 total carbon atoms; and less than 5% by weight of the polymer eluted below a temperature of 40°C in an ATREF test".

III. The contested decision was based on the claims as granted (main request) and on the claims of auxiliary requests 1-6 filed with letter of 4 October 2018 and of a further auxiliary request (considered as auxiliary request 7) filed on 4 December 2017.

IV. The decision of the opposition division was based on the following documents:

D2	WO 2005/002744 A1
D3	WO 2007/092853 A1
D4	Fraser, W. A. et al., Polyethylene Product Capabilities From Metallocene Catalysts with the UNIPOL® Process, 1997
D17	WO 97/44371 A1
D22	K.-B. Yoon and D.-H. Lee, Macromolecular research, Vol. 14, No. 2, pages 240-244, (2006)

V. As far as it is relevant to the present appeal, the decision of the opposition division can be summarised as follows:

- The patent in suit in the form of the main request was sufficiently disclosed. In particular, the feature in claim 1 relating to the "reversed comonomer distribution" was defined in paragraph 92 of the description and was exemplified in example 9.

- Claim 1 of the main request was novel over D2 because it was not shown that the polymers of D2 were such that less than 5% by weight of the polymers eluted below a temperature of 40°C in an ATREF test. In that regard, D22 was not relevant to the polymers of D2 since the polymers of D2 and D22 were based on different comonomers (C6 in D22 and C4 in D2) and were not prepared in the presence of the same catalysts. It was thus questionable whether the properties of the polymers according to D2 and D22 would be comparable, in particular their ATREF profiles.

- D4 was published before the priority date of the patent in suit. D4 could be seen as the closest prior art since it dealt with the same problem as the patent in suit, namely the processability of ethylene polymers. The polymers of examples II-A and II-B in Table 1 were particularly relevant. The ethylene polymers according to claim 1 of the main request differed from the disclosure in D4 only in that they had a reverse comonomer distribution.

- The patent in suit did not show that the reverse comonomer distribution of the ethylene polymers resulted in any effect. The problem was thus to provide alternative ethylene polymers.

- D17 concerned polyolefin copolymer compositions with a reverse comonomer distribution and long chain branching. D17 further taught that ethylene polymers with a reverse comonomer distribution had an improved processability and that that effect was not necessarily linked to long chain branching. Also, both D17 and D4 taught processes towards ethylene polymers according to claim 1 of the main request. Claim 1 of the main request lacked therefore an inventive step over D4 and D17 in combination.

- The claims according to the auxiliary requests either did not meet the requirements of Article 123(2) EPC or concerned subject-matter which did not involve an inventive step.

VI. The patent proprietor (appellant) lodged an appeal against that decision and filed auxiliary requests 1-8 with their statement setting out the grounds of appeal.

VII. In preparation of oral proceedings, the Board issued a communication dated 14 September 2021 including a preliminary opinion on the case.

VIII. Oral proceedings before the Board were held by videoconference on 26 January 2022.

IX. The appellant's submissions, in so far as they are relevant for the present decision, are essentially as follows:

Sufficiency of disclosure

- The objection against the lack of definition of the reverse comonomer distribution was an objection of lack of clarity that was not relevant in appeal. The skilled person also knew how to establish the presence of a reverse comonomer distribution from their common general knowledge as confirmed by the examples and figures of the patent in suit. Based on the definition provided in paragraph 92 and Figure 6 of the patent in suit both polymers of example 9 and comparative example 12 had a reverse comonomer distribution. Claim 1 as granted was thus sufficiently disclosed.

Novelty over D2

- D2 did not disclose the ATREF profiles of the polymers shown in the examples. D4 was not relevant since it concerned other polymers than those of D2. D22 also lacked relevance since the polymers it described were produced with a different metal in the catalyst which also led to polymers having a narrower molecular weight distribution (Mw/Mn) than in D2 and in the patent in suit. Moreover, D22 concerned monomodal copolymers while D2 concerned bimodal copolymers and in that regard D22 and D2 showed significant differences. Therefore, D2 did not disclose that less than 5% by weight of the polymer eluted below a temperature of 40°C in an ATREF test with the consequence that the polymer of claim 1 as granted was novel over D2.

Inventive step

D4 as the closest prior art

- Claim 1 as granted differed from polymers II-A and II-B of D4 in the presence of a reverse comonomer distribution and in the ATREF profile. Figure 7 of D4 did not show, nor represent one of the polymers II-A and II-B of D4. D4 did not disclose the preparation process, catalyst or commoner used for the preparation of polymers II-A and II-B so that it could not be inferred from D4 whether the polymers would satisfy the condition set out in claim 1 as granted with regard to the ATREF profile. In addition, the content of D4 was non enabling for polymers II-A and II-B.

- Starting from D4 as closest prior art, the patent in suit showed that the polymers according to claim 1 as granted had good physical properties, good processability and a good combination of properties in general. Paragraphs 2 and 4 of the patent in suit confirmed that the polymers produced had a broader molecular weight distribution (Mw/Mn), leading to a good processability.

- The problem solved was thus the provision of polymers with good physical properties and good processabilities. There was no teaching in D4 or D17 towards the combination of features of claim 1 as granted. In particular D17 concerned polymers with high level of long chain branching found to improve processability in the conditions of that document. That teaching was not relevant to D4 which concerned polymers II-A and II-B with no long chain branching.

- Furthermore, since the content of D4 was non enabling for polymers II-A and II-B, there was no teaching in that document that the skilled person could have relied on to modify the polymers at all. Claim 1 as granted was thus inventive over D4.

D2 as the closest prior art

- Claim 1 as granted differed from example 4 of D2 in the ATREF profile.

- Starting from example 4 of D2, the problem was the provision of a copolymer with good processability and good physical properties. The ATREF profile of the copolymers according to claim 1 as granted, in combination with the other features defined therein, was the solution to the problem posed.

- Increasing the weight average molecular weight of the polymer of example 4 of D2 would lead to long chain branching but there was no evidence that it would lead to a decrease of any elution peak below 30°C of the ATREF profile.

- Also, D22 concerned unimodal polymers while D2 concerned bimodal polymers. In that regard, D22 did not contain a teaching that could be relevant to the low molecular weight component as that present in the polymers of D2.

- Claim 1 as granted was therefore inventive also over D2.

X. The submissions of the opponent (respondent), in so far as they are relevant for the present decision, are essentially as follows:

Sufficiency of disclosure

- Claim 1 required a "reverse comonomer distribution", a feature for which the patent in suit did not disclose a method of measurement. There was therefore no way for a skilled person to verify whether that requirement was met or not. Also, the reverse comonomer distribution was ill-defined in the patent in suit. The amount of the higher molecular weight components that needed to have higher comonomer content was not specified. It was also unclear whether the reverse comonomer distribution required a continuous increase of the comonomer content with molecular weight as shown in example 9 or whether a higher comonomer content at any higher molecular weight was sufficient, as was the case for comparative example 12. The reverse comonomer distribution was therefore so obscure that it prevented the skilled person from preparing polymers according to claim 1 as granted with the consequence that claim 1 as granted was not sufficiently disclosed.

Novelty over D2

- Example 4 of D2 concerned an ethylene copolymer whose composition was disclosed in Table 2. That composition was prepared in the presence of a metallocene catalyst. Ethylene copolymers prepared with that type of catalysts had an ATREF profile according to claim 1 as granted as confirmed by D4 and in particular its Figure 7. Figure 3 of D22 also confirmed that comparable catalysts resulted in the same ATREF profile. The copolymer produced in example 4 of D2 anticipated therefore the subject-matter of claim 1 as granted.

Inventive step

D4 as the closest prior art

- D4 represented the closest prior art. It disclosed Univation ethylene polymers with broad molecular weight distribution that showed improved extrusion and bubble stability in blown film processing. In particular, Univation type (II) mLLDPEs had improved processing properties.

- Table 1 of D4 described Univation II ethylene copolymers having melt flow rates, molecular weight distributions and long chain branching according to claim 1 as granted. The molecular weight distribution values disclosed as PDI in table 1 ranged from 3.0 to 6.7 and showed that polymers II-A, II-B and II-C were within claim 1 as granted. Copolymer II-C in that regard had a molecular weight distribution of 6.3 which could also be seen as falling in the range of claim 1 as granted. Figure 7 demonstrated that there was no portion eluting in TREF under 40°C for Univation type II copolymers. The opposition division was correct in concluding that the TREF profile of the Univation type II copolymers in table 1 matched that of Figure 7.

- The ethylene polymers according to claim 1 as granted differed therefore from copolymers II-A, II-B and II-C in that it had a reverse comonomer distribution. That feature was ill-defined and unclear and did not contribute to a technical effect in the patent in suit. It should therefore not be considered in assessing the inventive step of a combination of features. The problem solved was thus the provision of alternative polymers. The use of ethylene polymers having a reverse comonomer distribution was only one of the obvious alternatives available to the person skilled in the art in order to solve the problem posed. Moreover, the use of a reverse comonomer distribution was known from D17. D17 made it clear that the reverse comonomer distribution was a feature of mLLDPEs and could be associated with improvements of processability. The teaching of D17 was applicable to D4 since D4 also concerned processability.

- The argument that improved processability in D17 was only associated with long chain branching (LCB) was incorrect. D4 was also clear that the Univation type (II) polymers had no LCB and no material eluting on TREF below 40°C.

- The skilled person also knew how to prepare ethylene polymers according to claim 1 as granted when starting from D4. When looking for suitable catalysts, D3 was a relevant disclosure that taught metallocene catalysts that could be used to produce such polymers. Claim 1 as granted therefore lacked an inventive step over D4.

D2 as the closest prior art

- D2 could also be chosen as the closest prior art. The only distinguishing feature of the polymer of claim 1 with respect to its example 4 was the ATREF profile of the polymer. There was no apparent technical effect associated with the ATREF profile required in claim 1 as granted so that it did not contribute to an inventive step.

- The good processability identified in the patent in suit was inherent to the polymers of D2 given that they already possessed the same molecular weight distributions. It was obvious to design the polymers of D2 with no portion eluting in ATREF at less than 40°C. As demonstrated in D4 and D22, metallocenes could give rise to polymers with no portion eluting at low temperature at the molecular weight distribution recited in claim 1 as granted.

- D2 taught the use of bis n-butylcyclopentadienyl hafnium dichloride in its examples. The bis n-butylcyclopentadienyl zirconium dichloride was an alternative to that catalyst and D22 demonstrated that that catalyst gave no low temperature ATREF material in ethylene hexene copolymers. In that regard the skilled person knew which catalysts to use in order to produce ethylene copolymers with an ATREF profile as defined in claim 1 as granted.

- It was also obvious to ensure that the polymers of D2 had an ATREF profile as defined in claim 1 as granted. If the skilled person wanted to minimize elution at low temperature it would be obvious to maximise, for example, density in order to reduce the amount of poorly crystalized/amorphous material that eluted at low temperature. Indeed, the reasons why materials might elute at low temperature were well known.

- The material eluting in ATREF at low temperature was known to be a low molecular weight or low density amorphous polymer fraction. As metallocenes generally gave narrow molecular weight distributions, there was typically no low crystallinity fraction in copolymers produced by these catalysts.

- Claim 1 as granted therefore lacked an inventive step over D2.

XI. The appellant requested that the decision under appeal be set aside and that the patent be maintained as granted or in the form of one of auxiliary requests 1-8 submitted with the statement setting out the grounds of appeal.

XII. The respondent requested that the appeal be dismissed.

Reasons for the Decision

1. Admissibility of the appeal

The question of the payment on time of the appeal fee was raised by the respondent in their reply to the statement setting out the grounds of appeal (point 2). That question was addressed in the communication of the Board dated 14 September 2021 (Section 6), the data available showing that the appeal fee had been paid online with the notice of appeal. Since the respondent stated at the oral proceedings before the Board that the admissibility of the appeal was no longer put into question, there is no reason for the Board to address that issue any further.

Main request

2. Sufficiency of disclosure

2.1 Lack of sufficiency of disclosure was pursued in appeal with regard to the reverse comonomer distribution defining the ethylene polymer according to claim 1 as granted. The argumentation of the respondent in that respect was that the reverse comonomer distribution was not clearly defined in the patent in suit, either directly or by way of a test method. The respondent considered that the skilled person would thus not be able to ascertain whether any ethylene polymer had a reverse comonomer distribution or not, which would be supported by the fact that both copolymers of example 9 and comparative example 12 could be seen as having a reverse comonomer distribution on the basis of the short chain branch distribution shown in Figure 6.

2.2 Reverse comonomer distribution is defined in the context of ethylene polymers in paragraph 92 of the patent in suit as referring to a polymer in which the higher molecular weight components of the polymer have higher comonomer incorporation than the lower molecular weight components. Paragraph 92 also teaches that the process conditions and the catalyst system described in the patent permit to obtain a reverse comonomer distribution. It is also apparent from examples 9 (paragraph 116), 20-25 (paragraph 124) and 26/27 (paragraph 125) of the patent in suit that the use of a catalyst, such as MET 1 defined in Figure 1, leads to copolymers having a reverse comonomer distribution. These examples also disclose the processes and conditions that were carried out to achieve ethylene copolymers having a reverse comonomer distribution and that were according to claim 1 as granted.

2.3 The respondent contended that the patent in suit did not disclose the necessary guidance to obtain polymers having a reverse comonomer distribution. However, the respondent failed to identify what necessary guidance was missing in the patent in suit or in the common general knowledge.

2.4 In addition, the fact that the definition in paragraph 92 of the patent in suit is a broad one with the consequence that a copolymer like the one of comparative example 12 of the patent in suit also meets the condition (see Figure 6) and is found to possess a reverse comonomer distribution, which was not in dispute between the parties, does not as such establish a lack of sufficiency of disclosure. Like the copolymers of examples 9, 20-25 and 26/27 which are representative of claim 1 as granted, the copolymer of comparative example 12 was prepared with the MET 1 catalyst (Table III). The presence of a reverse comonomer distribution on the copolymer of comparative example 12 is thus coherent with the teaching of the patent in suit regarding the role played by the choice of the catalyst system. Also, comparative example 12 is comparative at least in so far as its values of melt index and Mw/Mn (Table III) are outside the ranges defined in claim 1 as granted. Therefore, comparative example 12 does not support the argument of lack of sufficiency of disclosure of the respondent.

2.5 While the patent in suit does not disclose a detailed method for the measurement of the reverse comonomer distribution on an obtained copolymer, it is apparent from paragraphs 116 and 125 and Figures 6 and 10 that the determination of the reverse comonomer distribution in the patent in suit was based on a measurement of the short chain branching distribution (SCBD) defined in paragraphs 93 and 94. The patent in suit offers therefore some guidance as well on how it can be established whether or not a given ethylene copolymer has a reverse comonomer distribution. Other methods of determination of the reverse comonomer distribution exist in the prior art, as apparent from D17 (page 3, line 15 - page 4, line 23), and these methods may lead to a different result than the one used in the patent in suit. However, this fact is not sufficient to call into question the sufficient disclosure of the patent. The ambiguity of claim 1 as granted in that regard is a question of lack of clarity, which is not open to discussion in opposition proceedings with respect to a feature present in granted claim 1.

2.6 Under these circumstances the Board finds that it has not been established that the ground for opposition under Article 100(b) EPC prejudices the maintenance of the patent.

3. Novelty

3.1 The opposition division concluded in their decision that claim 1 of the main request was novel over D2 because it had not been shown that the polymers produced in the examples of D2 were such that less than 5% by weight of the polymer eluted below a temperature of 40°C in an Analytical Temperature Rising Elution Fractionation (ATREF) test. In appeal, the objection of lack of novelty over the disclosure of D2 was directed to example 4 of D2 and based on arguments which the opposition division had already addressed in the contested decision, but without actually showing how the reasoning laid out in the decision was incorrect.

3.2 The ATREF profile of a copolymer is a characterization of the short chain branching distribution of the copolymer (paragraph 95 of the patent in suit) which is linked to the molecular weight of the polymer and the distribution of the comonomer in the polymer (paragraph 93). No information on the ATREF profile is available in D2.

3.2.1 The contested decision established that the teachings of D22 regarding the ATREF profile of specific copolymers could not be directly applied to D2 because D22 and D2 concerned different copolymers obtained by different processes. D22 indeed discloses the preparation of copolymers based on ethylene and 1-hexene (D22, page 240, right column, first paragraph) while example 4 of D2 concerns a copolymer obtained from three monomers, ethylene, 1-hexene and 1-butene (Table 2 and description of the examples starting on page 17). Furthermore, the preparation of the copolymers in D22 and D2 involve different catalysts, a zirconium catalyst in D22 (supra) and a hafnium catalyst in D2 (catalyst preparation in example 1 on page 15). Thus, the copolymers of D22 and D2 show significant compositional differences as they are based on a different comonomer mix and they are produced by a catalyst based on a different metal. Without evidence to the contrary from the side of the respondent, it cannot be assumed that these differences will not have an influence on the ATREF profiles of the copolymers. In that regard, it has not been established that the ATREF profile of copolymers of ethylene and 1-hexene shown in Figure 3 of D22 was relevant to the terpolymer of example 4 of D2.

3.2.2 D4 discloses polyethylenes prepared from metallocene catalysts (page 6). The passage in the second column on page 8 more specifically teaches that the copolymers reported in Table 1 of D4 were prepared by a process called UNIPOL®I but there is no further information in D4 about which catalyst was used in that process and on which comonomers the copolymers were based on. While Figure 7 of D4 discloses the ATREF profile of a copolymer Univation of type II, there is no information in D4 from which it could be concluded that this ATREF profile also corresponds to the copolymer of example 4 of D2. In particular, it cannot be inferred from D2 and D4 that comparable catalysts and monomers were used in the process. Furthermore, the melt flow rate of the copolymer according to example 4 of D2 (9.0 g/10 min) differs significantly from that of the copolymer shown in Figure 7 of D4 (1.0 g/10 min), which is a clear indication that these copolymers are different. In that regard, the Board does not find that D4 constitutes evidence for the assertion that the ATREF profile shown in Figure 7 of D4 corresponds to that of example 4 of D2.

3.3 Therefore, the Board finds that it cannot be concluded therefrom that the copolymers of D2 would necessarily have less than 5% by weight of the polymer eluting below a temperature of 40°C in an ATREF test as defined in claim 1 as granted.

3.4 Claim 1 of the main request is therefore novel over the disclosure of D2.

4. Inventive step

4.1 The reply to the statement setting out the grounds of appeal contained objections of lack of inventive step in view of D4, D2 and D3 as alternative documents to be taken as the closest prior art. The objection based on D3 was however withdrawn at the oral proceedings before the Board with the consequence that only the objections based on D4 and D2 as the closest prior art need to be dealt with in the present decision.

4.2 D4 as the closest prior art

4.2.1 The contested decision established that claim 1 of the main request lacked an inventive step over D4 as the closest prior art in combination with D17.

4.2.2 The patent in suit concerns the production of ethylene copolymers having a broad molecular weight distribution using a metallocene-based catalyst system (paragraph 4). D4 discloses ethylene copolymers produced by the Univation metallocene technology allowing a control of the molecular weight distribution of the copolymer (page 7, first column, penultimate paragraph). Among the copolymers produced according to the technology disclosed in D4 (Univation-Type I, II and III copolymers), the Univation-Type II copolymers are disclosed on page 8 (second column) as having broad molecular weight distributions and no long chain branching. In that regard, the Univation-Type II copolymers disclosed in D4 are a reasonable starting point for the assessment of inventive step. Within D4, the Type II copolymers shown in examples II-A and II-B of D4 were considered to be the most relevant in the contested decision and in the submissions of the respondent, in particular because these polymers, in the light of the whole disclosure of D4, were according to claim 1 as granted except for the absence of a reverse comonomer distribution (section 2.4.5 of the contested decision).

4.2.3 The properties of the ethylene copolymer compositions of examples II-A and II-B are disclosed on page 9 of D4 in Table 1 (Univation Type-II mLLDPE). The compositions have a melt index of 1.1 g/10 min (II-A) and 2.0 g/10 min (II-B), a molecular weight distribution (PDI) of 3.0 (II-A) and 4.8 (II-B) and no long chain branching (LCB /1000 CH2 of 0). The respondent additionally considered that copolymer II-C in Table 1 (melt index of 0.9 g/10 min and no LCB) was relevant on the ground that its molecular weight distribution (6.3) could be seen as falling in the range of about 3 to 6 defined in claim 1 as granted. The Board considers that, disregarding the higher value of molecular weight distribution, copolymer II-C does not substantially differ from copolymers II-A and II-B so that the following assessment of inventive step equally applies to each of copolymers II-A, II-B and II-C.

4.2.4 None of the copolymers II-A, II-B or II-C is disclosed as a copolymer with a reverse comonomer distribution in D4. D4 does not even disclose which comonomers were used in any of copolymers II-A, II-B and II-C, nor does it give any detail about the preparation or the comonomer distributions of the copolymers. In that regard, there is no evidence on file from which it could be concluded that the copolymers II-A, II-B or II-C had a reverse comonomer distribution.

4.2.5 Figure 7 on page 9 of D4 shows TREF analyses as a function of temperature (Analytical TREF traces) for a Z/N LLDPE copolymer (UNIPOL Z/N LLDPE 1.0 MI, 0.918 g/cc) and a Univation-Type II mLLDPE (U-Type II mLLDPE 1.0 MI, 0.918 g/cc). The values of melt index and density of the Univation-Type II mLLDPE copolymer of

Figure 7 do not correspond to the values provided for the Univation-Type II copolymers reported in Table 1. On that basis it can only be concluded that the Univation-Type II mLLDPE copolymer of Figure 7 is a further polymer that does not correspond to the copolymers II-A, II-B or even II-C reported in Table 1. Moreover, no information is available in D4 that the data of Figure 7 should apply to other copolymers, with the consequence that the data shown in Figure 7 cannot provide any information on the ATREF feature of claim 1 for copolymers II-A, II-B or II-C.

4.2.6 No different conclusion can be reached by considering the composition distribution index (CDI) of the copolymer of Figure 7 and one of copolymers II-A, II-B or II-C. The CDI is defined on page 8 (first column) as being a parameter derived from analytical TREF data that quantifies the distribution of chain segment lengths between branch points, defining a crystallizable chain length distribution. While the CDI derives from the TREF profile of a given polymer, there is no information on file from which it could be concluded that a given value of CDI as defined in D4 corresponds to an amount of polymer eluting below the temperature of 40°C. In that regard, the fact that the Univation-Type II copolymers disclosed throughout D4 (Tables 1, 2 and 3) have a CDI in the range of 1.5 to 2.6 is as such irrelevant to the determination of the elution profile of the copolymers II-A, II-B and II-C.

4.2.7 It follows that claim 1 as granted differs from the relevant copolymers of D4 in that the ethylene copolymers have a reverse comonomer distribution and have less than 5% by weight of copolymer eluting below 40°C in an ATREF test.

4.2.8 The patent in suit concerns ethylene copolymers that have a broad molecular weight distribution and that are produced using a metallocene-based catalyst system in the presence of hydrogen (paragraph 4). Examples 20-27 show that the use of a catalyst such as MET 1 defined in Figure 1 leads to copolymers according to claim 1 as granted (Table IV and figures 10/11) with a molecular weight distribution of between 3.36 to 4.29 (Table IV).

4.2.9 However, the examples of the patent in suit do not establish the presence of an improvement over the compositions of D4, in particular not one related to the distinguishing features. The appellant referred in their statement setting out the grounds of appeal (sections 2.27 and 2.28) to a direct comparison of the copolymers according to the patent in suit with the composition of example 4 of D17. It has however not been shown how that composition of D17 could be seen as representative of the compositions II-A to II-C of D4, in particular since the comonomer present in the copolymers of D4 is unknown and the preparation processes of these copolymers cannot be compared due to the absence of details about it in D4. In that regard, the comparison made with D17 was not shown to be relevant to the determination of an improvement over the closest prior art D4. In their letter dated 24 January 2020 (point 3.3), the appellant also referred to arguments provided during the opposition proceedings on 4 December 2017 and 4 October 2018 without, however, showing in the appeal proceedings how these arguments constituted an evidence of an improvement over D4. On that basis the Board does not find that an effect has been shown for the compositions according to claim 1 as granted over the relevant copolymers of D4.

4.2.10 The problem that can be defined starting from D4 is, therefore, the provision of further ethylene polymers with a broad molecular weight distribution using a metallocene-based catalyst system.

4.2.11 It remains to be determined whether the solution to this problem is obvious starting from copolymers II-A, II-B and II-C reported in Table 1 of D4. In order to answer that question, it has to be established whether a skilled person, on the basis of the information of D4 and their common general knowledge, would have been able to produce ethylene copolymers according to claim 1 as granted starting from the copolymers II-A, II-B and II-C of D4. In that regard, the question is not whether the features defining the ethylene polymers according to claim 1 as granted over D4 were separately known and could individually be achieved but rather whether, by starting from the copolymers II-A, II-B and II-C of D4, the skilled person had the knowledge which allowed them to produce the ethylene compositions defined in claim 1 as granted.

4.2.12 The respondent referred to D17 and in particular its example 4 as providing a relevant teaching about the production of ethylene copolymers with reverse comonomer distribution. D4 however discloses almost no detail as to the preparation of the copolymers II-A, II-B and II-C, not even the comonomers used, the catalyst involved in the polymerization or any details of the process needed to arrive at the specific Univation-Type II copolymers (UNIPOL® is cited but without providing further information on this process). Apart from the properties disclosed in Table 1, D4 does not provide any teaching that would need to be considered in order to determine whether it could reasonably be modified according to the teaching of

D17.

4.2.13 The skilled person is thus left in the dark as to whether the catalyst and process conditions disclosed in D17 and more specifically in example 4 of this document are at all compatible with the process for the preparation of Univation-Type II copolymers of D4. The mere consideration that the melt index, molecular weight distribution and long chain branching of the obtained copolymer are similar in D4 and D17 is not at all sufficient to suggest that the use of the catalyst or process conditions disclosed in example 4 of D17 could be transposed to D4 and lead to copolymers according to claim 1 as granted, especially since it is not even known whether the copolymers of D4 and D17 are based on similar comonomers.

4.2.14 It is also apparent from example 4 of D17 that the ATREF test of the copolymer (page 8, line 7 and Figure 4) shows an elution peak below 40°C that represents more than 5% by weight fraction, which also does not make it credible that even a possible application of the teaching of D17 to the copolymers of D4 would lead to the polymer of claim 1. The respondent expressed doubt as to the meaning of the peak in Figure 4 of D17, but no evidence was provided that could explain the peak other than what the ATREF profile is meant to represent, namely the weight fraction of copolymer eluting at a given temperature.

4.2.15 Reference was also made to D3 as a document pertaining to the preparation of copolymers with low LCB and no "insoluble portion" (reply to the statement of grounds of appeal, page 11, sections 73 and 74). A low amount of LCB as such as referred to by the respondent is not evidence, however, that the copolymers produced had "less than 0.008 long chain branches (LCB) per 1000 total carbon atoms" according to claim 1 as granted. Also, D3 does not refer to the elution ATREF profile of the polymers produced. The passage on page 70, line 10 of D3 contains a vague reference to the absence of "insoluble polymers" in polymers prepared according to some examples of D3 but that cannot be seen as being equivalent to a polymer having "less than 5% by weight of the polymer eluted below a temperature of 40°C in an ATREF test" as required in claim 1 as granted. Moreover, the unspecific reference to the catalysts disclosed in D3 was not shown to allow the preparation of copolymers satisfying the combination of features set out in claim 1 as granted. In particular, starting from the Univation-Type II-A to II-C polymers of D4 it was not shown that the use of catalysts from D3 leading to low LCB would still provide copolymers having the combination of melt index, Mw/Mn and LCB according to claim 1 as granted. In that regard, the reference to the disclosure of D3 is not relevant to the question posed.

4.2.16 Under these circumstances, the Board concludes that it has not been shown that starting from D4 the skilled person taking into account the teaching of D17 and D3 and aiming at providing further copolymers would have arrived at the polymer of granted claim 1. On that basis, it must be concluded that a lack of inventive step starting from document D4 has not been proven.

4.3 D2 as the closest prior art

4.3.1 It was further submitted that claim 1 of the main request lacked an inventive step starting from D2 and in particular from its example 4.

4.3.2 D2 concerns the preparation of bimodal copolymers of ethylene comprising at least two comonomers (page 3, lines 8-14), which are not excluded from the scope of claim 1 as granted. The copolymer of example 4, produced from ethylene, 1-butene and 1-hexene (Table 2, page 24), has a molecular weight distribution that can be calculated from Table 2 as being 3.6, which is within the range of claim 1 as granted, and is produced with a metallocene catalyst (catalyst preparation example 1 on page 15 lines 12-25).

4.3.3 Considering that the patent in suit concerns the production of ethylene copolymers having a broad molecular weight distribution using a metallocene-based catalyst system (paragraph 4) which also encompass bimodal polymers, the copolymer of ethylene, 1-butene and 1-hexene of example 4 of D2 is a reasonable starting point for the assessment of inventive step of claim 1 as granted.

4.3.4 The copolymer of example 4 of D2 has a melt index (MFR_2 of 9.0 g/10 min in Table 2) in the range defined in claim 1 as granted (about 0.1 to about 100 g/10 min). The evidence provided by the respondent concerning the presence of a reverse comonomer distribution (related to the higher amount of 1-hexene comonomer added in the last part of the polymerization than of 1-butene according to Table 2) and an amount of long chain branching according to granted claim 1 (by calculation based on the definition provided in paragraph 126 of the patent in suit, see decision point 2.3.2 and section 66 of the letter of 7 December 2021 of the respondent) was not disputed by the appellant. The Board has no reason to take a different position.

4.3.5 It was however acknowledged that D2 did not provide the elution profile of the copolymers produced. Claim 1 as granted therefore differs from the copolymer of example 4 of D2 in that the ethylene copolymers are such that less than 5% by weight of the copolymer eluted below a temperature of 40°C in an ATREF test.

4.3.6 It was not in dispute that the patent in suit did not provide evidence of an effect of the ethylene copolymers according to claim 1 as granted over the copolymer of example 4 of D2 taking into account the distinguishing feature. The problem that can be formulated is therefore the provision of further ethylene polymers with a broad molecular weight distribution using a metallocene-based catalyst system.

4.3.7 It remains to be determined whether the solution to that problem is obvious starting from the copolymer of example 4 of D2. In that regard, the central question is whether it was shown that the skilled person would have been able to produce ethylene copolymers according to claim 1 as granted starting from the copolymer of example 4 of D2. The question is not whether the features defining the ethylene polymers according to claim 1 as granted over D2 were separately known and could individually be achieved but rather whether, by starting from D2, the skilled person had the knowledge which allowed them to produce the ethylene compositions defined in claim 1 as granted.

4.3.8 The argumentation of the respondent in this respect relied solely on the teaching of D22. D22 concerns the copolymerization of ethylene and 1-hexene using an activated metallocene catalyst (page 240, second column, first paragraph). In D22 the molecular weight distribution (Mw/Mn) of the produced copolymers is determined (Table 1) and the short chain branching of the copolymers is discussed on the basis of their TREF profiles (Figure 3). The molecular weight distribution (Mw/Mn) of the copolymers varies, as a function of the cocatalyst, between 2.3 and 2.6 (Table 1), outside the range of claim 1 as granted. D22 also discloses that the highly crystalline fraction was not detected on the copolymers produced, as can be seen on the TREF profiles of the copolymers which do not contain a peak for low temperatures, in particular no peak below 40°C. The respondent concluded therefrom that D2 showed that metallocenes can give rise to polymers with no portion eluting at low temperature at the molecular weight distribution of claim 1 as granted.

4.3.9 It was however not shown why, starting from the copolymer of example 4 of D2 which is a bimodal copolymer based on three monomers (ethylene, butene and hexene), the skilled person would have considered the teaching of D22 about copolymers of ethylene and 1-hexene not disclosed as being bimodal polymers. It was further not shown how the teaching of D22 would have been applied to D2 in particular since the polymerization processes of these two documents are also different. In particular, it was not laid out by the respondent how the process used in the preparation of the copolymer of example 4 of D2 had to be modified in order to obtain an elution profile according to claim 1 as granted while maintaining all other features according to granted claim 1. The mere similarity of the catalysts used in D2 and D22 is in that respect insufficient, in particular since Table 1 of D22 shows that the molecular weight distribution (Mw/Mn) of the copolymers of ethylene and hexene produced under the conditions of D22 can be as low as 2.3, which is outside the scope of claim 1 as granted.

4.3.10 Under these circumstances, the Board concludes that it has not been shown that starting from example 4 of D2 the skilled person taking into account the teaching of D22 and aiming at providing further copolymers would have arrived at the polymer of granted claim 1. On that basis, it must be concluded that a lack of inventive step starting from document D2 has not been proven.

5. The grounds for opposition do not prejudice the maintenance of the patent.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The patent is maintained as granted.

The Registrar: The Chairman:

Beschwerdekammern des Europäischen Patentamts
Boards of Appeal of the European Patent Office
Chambres de recours de l'Office européen des brevets

B. ter Heijden D. Semino

Decision electronically authenticated